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Preface

The 21st International Symposium on Lepton and Photon Interactions marked the return of the Symposium to Fermilab at the start of the Run 2 collider era of the Tevatron. As of 11-16th August 2003, the Tevatron has delivered an integrated luminosity surpassing that of the previous collider run. Whereas the 9th Symposium, held at Fermilab in 1979, marked the start of construction of what was then called the “Energy Saver/Doubler”, this one saw the newest accelerator at Fermilab – the Main Injector – in full operation for both protons and antiprotons. The Main Injector has already boosted the instantaneous luminosity of the Tevatron collider by a factor ~ 50 compared to the original design luminosity presented in 1979 for the “Energy Saver/Doubler”. Soon to join the presently running MiniBooNE experiment will be a new neutrino program at Fermilab powered by the intense proton beams provided by the Main Injector. This year saw the completion of the MINOS far detector and the NUMI neutrino beamline will soon be completed.

At the 9th Symposium the first evidence for gluons was presented and QCD emerged as the theory that could describe what was known about hadrons. It was hoped that QCD would soon be near to gaining the stature of QED. With this Symposium a major breakthrough has been realized. Lattice QCD has reached a new level of precision, where errors on calculated quantities can at last be reliably quantified at the several % level. Soon, instead of just testing QCD we will be using it to help us determine more precisely the parameters of the Standard Model and to look for New Physics. Other highlights for this Symposium included the vast amount of new data from the B -factories with the tantalizing possibility of non-Standard Model CP-violation in ϕK_S^0 , and the discovery of a new, as yet unexplained, particle, the $X(3872)$. The incredible progress in neutrino physics was again evident with the last pieces of the solar neutrino problem finally coming into place and settling on the LMA-1 solution. However we were reminded how much we still need to understand by the talks on Dark Matter and Dark Energy. The talks also showed the synergy between different areas of particle physics and of astroparticle physics and cosmology, especially in the search for New Physics at

the TeV energy scale.

While still following the traditional program of review talks, for this edition of the Symposium a real effort was made to increase active participation throughout the Symposium. This was partly achieved by holding breakout discussion sessions between the formal plenary talks. There, the speakers from several sessions were available for an extended “Question and Answer” session. These new sessions were enormously successful, and the only regret maybe is that we do not have a written record of these discussions. However this probably allowed for a more informal and relaxed atmosphere. Additional participation was also generated by another new introduction to the Symposium, a “Physics Posters” session. There were 66 physics posters presented over two days, many by energetic young physicists. These posters included results from 20 different experiments as well as posters on theory, analytic techniques, and detector development. A “Laboratory Posters” day was again held with the participation of 15 laboratories, based in 8 different countries. In addition, one evening was devoted to a special session on the GRID, comprising an interesting program with both talks and posters.

Another aim for this Symposium was to increase the participation of younger scientists, who are the future of the field. Not only was this achieved by holding the new “Physics Posters” session, but younger scientists were involved throughout the whole Symposium. These included the speakers, the local organizing committee, the Scientific Secretaries, and the Proceedings editors.

A major effort at this Symposium was public outreach. Members of the press held special discussion sessions with scientists on various physics topics; and there was a special press conference with the Laboratory Directors. The public outreach effort included interaction with the public during several hours in the Field Museum in Chicago, with coverage by the press. There were also excellent “Plain English” articles written on seven different particle physics and cosmology topics available via the Symposium website. At the public lecture, Fermilab director, Mike Witherell, gave an inspiring talk on “New Questions about Matter, Space and Time”

to a packed audience of the local public. Capping off these outreach efforts was the launch of Interactions.org, a multinational web site designed as a central resource for communicators of particle physics.

Following the excellent efforts of LP2001 on keeping a good record of the Symposium, we have tried to provide as good a record as possible via the web site and through a DVDROM included with the hardcopy of the proceedings. This will provide a lasting record of the live webcast streaming video for each talk, the talk slides, the writeups of each talk,

the public lecture, and the physics and laboratory posters.

We feel that the synergy between different areas of particle physics and cosmology that was so evident at LP2003 can be viewed as a combined attack to dispel the veil at the TeV energy scale. This effort is continuously pulling at this veil and foreshadows the bursting forth of New Physics that will overwhelm, delight, excite, and inspire us. We hope that LP2005 will bring us a glimpse of this future era.

Harry W. K. Cheung
and
Tracey S. Pratt
Proceedings Editors

Acknowledgments

On behalf of the 2003 Lepton-Photon Symposium Chairperson, Cathy Newman-Holmes, we would like to thank the many people in every part of the lab that helped us out to successfully hold a conference of the size of LP2003.

Special thanks goes to Keith Ellis, the Scientific Program Chair, for arranging a wonderfully interesting and balanced program, and all the speakers for their hard work and effort in producing excellent and engrossing reviews. We also thank the International Advisory Committee for advice and suggestions on the program. We thank the respective subcommittees of the Local Organizing Committee and the Scientific Secretaries for classifying all the contributed papers, for providing technical help to speakers, for their support during the talk sessions, and for their help with the Symposium website. We thank Fred Ullrich and his staff and helpers from the Fermilab Visual Media Services for taking care of the live webcast, the talk and poster presentation details, and for capturing the Symposium on a set of splendid photographs.

As chair of the Events Subcommittee, Joel Butler also deserves special thanks for planning a full

and varied program of excellent events throughout the Symposium, including the Symposium Banquet at Navy Pier and the special GRID session. Some high profile and influential speakers were attracted for this latter event, and we thank Cisco Systems, Hamamatsu and Sun Microsystems for their sponsorship. Our thanks go to Judy Jackson, head of the Public Affairs Office, for organizing a spectacular program for the press and for public outreach. Special thanks also goes to Cynthia Sazama, head of the Conference Office, for leading a superb staff from the various divisions within Fermilab in looking after all the neverending “little details” of running the Symposium.

Finally, for support that made this Symposium possible, our thanks go to the International Union of Pure and Applied Physics, the U. S. Department of Energy, the National Science Foundation, the Universities Research Association, ITech-Okinawa, NASA and of course Fermilab. The Fermi National Accelerator Laboratory is operated by the Universities Research Association, Inc., under contract DE-AC02-76CHO3000 with the U. S. Department of Energy.

Editors' Acknowledgments

We would like to thank Cathy Newman-Holmes, Chair of LP2003, for giving us the opportunity and full responsibility for producing these proceedings. We made a special effort to try to publish these proceedings in the shortest possible time and we would like to thank all authors for delivering their contributions in a timely manner, while maintaining high standards in content and format. Regretably a few contributions were not received. We also thank all authors for letting us try to improve the style, format and the consistency of the whole volume – especially the U. K. authors for letting us change from British to U. S. spelling in their writeups!

We wish to thank the following people for help-

ing out with the production of these proceedings. Jim Shultz and Fred Ullrich for help with producing the DVDROM; Cynthia Sazama and Suzanne Weber for help with logistics; the Scientific Secretaries for help with the Discussion sections for each paper; Pushpa Bhat for help with getting laboratory poster files; Fred Ullrich for help with photo selections for the cover and endpapers; Keith Ellis, Andreas Kronfeld and Chris Quigg for help with trying to get writeup contributions; and the production staff at World Scientific – Karen Yeo, Jimmy Low and Rajesh Babu for producing the cover and for help with various production issues.

Harry W. K. Cheung
and
Tracey S. Pratt

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Reidar Hahn and Deborah Guzman of the Fermilab Visual Media Services took all the photos contained in these proceedings, (except for the ones mentioned below) Photos from the Symposium Banquet were provided by Doris Kim and the photos for the first “Behind the Scenes” page came from Leticia Shaddix. The photo for the cover was taken by Fred Ullrich, and Reidar Hahn took the photos used

for the front and back endpapers. We thank each of you for the use of these excellent photographs. All the Visual Media Services 2003 Lepton-Photon Symposium photos can be obtained from the Fermilab Visual Media Services online photo database: search for captions with “Lepton Photon” at http://vmsfmp2.fnal.gov/v1/VMSSearch_Online.htm.

Descriptions of Cover and Endpaper Photos

Cover: Broken Symmetry

The tri-span sculpture, called “Broken Symmetry” rises 50 feet above the road at Fermilab’s Pine Street entrance. It exemplifies the notions of symmetry and symmetry-breaking that are so important in the physics of elementary particles. Although asymmetric from most angles, when viewed from directly above or below the apex, the structure appears per-

fectly symmetric. This 21 ton “gateway” is made from the steel armor plates of the U. S. Navy aircraft carrier, Princeton, which was decommissioned in May, 1956. The steel from this and other surplus decommissioned U. S. Navy battle ships are used at Fermilab for radiation shielding.

Front Endpaper: Ariel view of the Fermilab accelerator complex

Ariel view of the Fermilab accelerator complex. The large ring on the left indicates the location of the Main Injector, Fermilab’s newest accelerator. The larger four mile ring on the right shows the location

of the Tevatron. Robert Rathbun Wilson Hall, the “Highrise”, is clearly visible in the center. This is named for Fermilab’s founding director.

Back endpaper: View over prairie of Wilson Hall and Lederman Science Center

Looking over an open tallgrass prairie which is a part of Fermilab’s Prairie Reconstruction Project. This is an effort to retrieve some of the awesome beauty of the old prairies, as well as the biodiversity of native grassland ecosystems. Wilson Hall can be seen in the background on the right, and on the left

is the Lederman Science Center, named for Nobel Laureate and former Fermilab Director, Leon M. Lederman. This visitor center is very popular with the local public and surrounding schools for gaining hands-on experience exploring how Fermilab physicists understand nature’s secrets.